Space Weather Technical Forecast

Issued on Monday, 25 April 2022 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (R1/R2 Radio Blackouts), with a slight chance of X-class flares (R3 Radio Blackouts). Slight chance of Active fluence by the end of the period.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low with only C-class flares observed. There are now six sunspot regions on the disc, the largest and most prominent of these being AR2993 and AR2994 in the northwest. Both are large regions with some magnetic complexity, and as such these make up the majority of the flare risk at the present time. All other regions are smaller and simpler, although AR2995 near north centre disc is showing signs of some magnetic complexity, and regions near the southeast limb have given some recent (non Earth directed) CME activity. No Earth-directed CMEs have been observed in available imagery during the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has been largely unremarkable, although with slightly elevated wind speeds suggesting perhaps a weak connection to the HSS of CH77/+. Solar wind speeds have been mostly at slightly elevated levels, varying between 430-530 km/s. The density has been at average or below average levels. The Interplanetary Magnetic Field strength, Bt, has been weak at 6nT or below, with the north-south component, Bz, varying weakly between +5/-4nT. Phi angle was mainly positive throughout. Geomagnetic activity was Quiet (Kp 0-2) throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) was at background levels throughout. The high energy electron flux (greater than 2MeV) has been at background to Moderate levels throughout, peaking at 358 pfu at 24/1730UTC. The associated 24 hour fluence was below the Active (1e8 integrated pfu) level, with 8.89e6 integrated pfu recorded at 25/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar Activity is currently Low, with a chance of reaching Moderate levels, most likely from AR2993 or AR2994. There is a slight chance of this increasing to High due to an isolated X-class flare. The chances of an M-class flare increase slightly through the period as further regions rotate onto the southeast limb.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on the 21st was forecast to pass Earth's orbit late on 24 April, with a slight chance of a glancing interaction. There remains a continuing but declining risk through the early part of Day 1 (25 Apr) that we may see a glancing blow from this feature. The current slightly elevated wind speeds may be due to a weak interaction with CH77/+. Wind speeds are likely to slowly fall back to ambient levels later on Day 1 and into Day 2 (25-26 Apr). No further sources of enhancement are expected at the current time.
Geomagnetic activity is forecast to be mostly Quiet to Unsettled through this period. There is a chance of Active intervals, with a very slight chance of a G1/Minor Storm interval, in the event of any CME interaction on Day 1.

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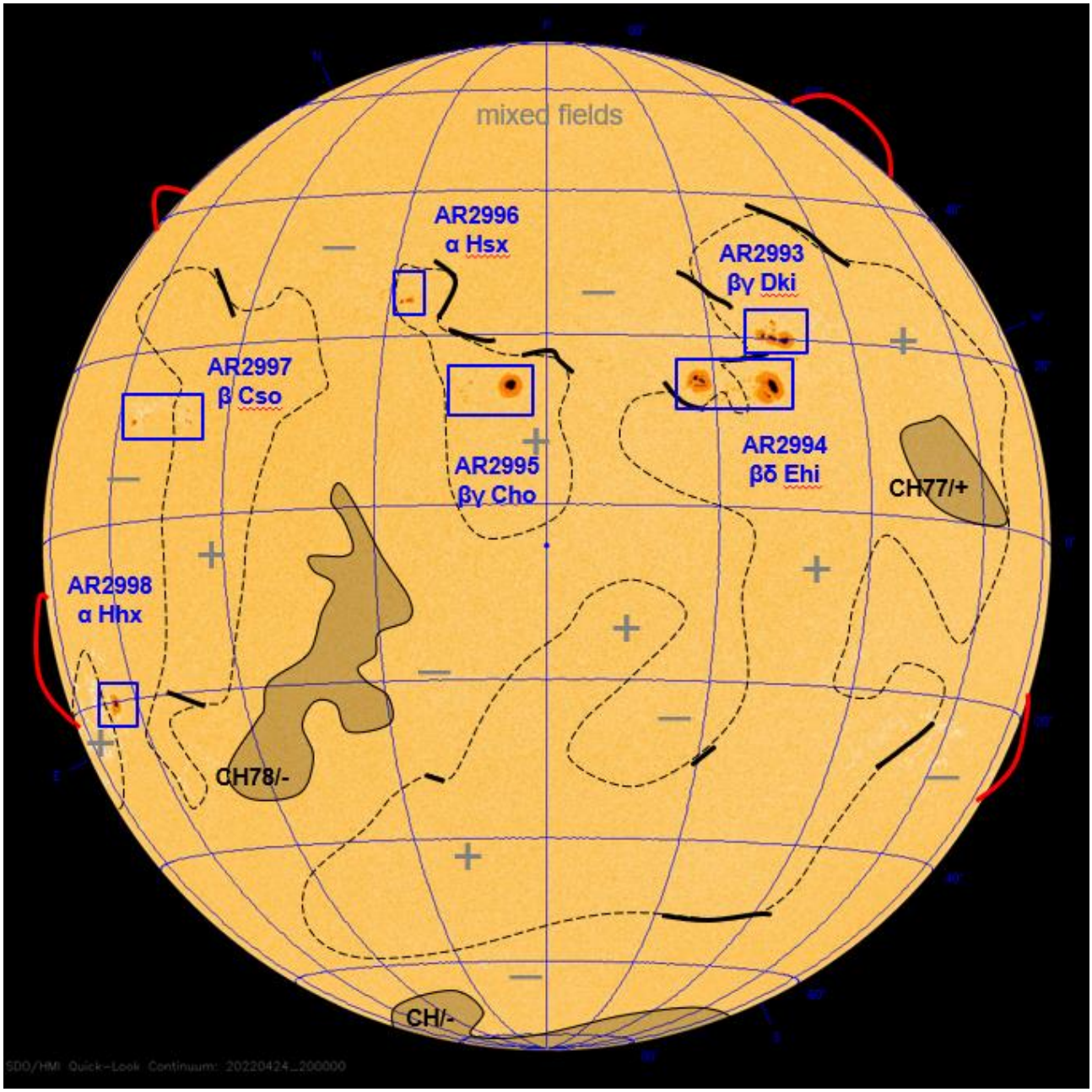
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is at Background levels, and is most likely to remain so through the next four days. However, AR2993 and AR2994 are now transiting the northwest quadrant and together bring a slight chance of solar radiation storms reaching Earth. The high energy electron flux (greater than 2MeV) is expected to be at mainly background to moderate levels, perhaps rising slightly through the period. Electron fluence is most likely to remain below the Active (1e8 integrated pfu) threshold, with a slight chance of rising above by the end of the period.

Figure 1. Solar Analysis Valid 24/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME which left the Sun on the 21st due to an M9.6 flare from AR2993 was forecast to pass Earth's orbit late on 24 April, likely missing behind and to the north of Earth, but with a slight chance of a glancing interaction. There remains a continuing but declining risk through the early part of Day 1 (25 Apr) that we may see a glancing blow from this feature.

The current slightly elevated wind speeds may be due to a weak interaction with CH77/+, which is now well to the west of the disc. Wind speeds are likely to slowly fall back to ambient levels later on Day 1 and into Day 2 (25-26 Apr). No further sources of enhancement are expected at the current time.

Geomagnetic activity is forecast to be mostly Quiet to Unsettled through this period. There is a chance of Active intervals, with a very slight chance of a G1/Minor Storm interval, in the event of any CME interaction on Day 1.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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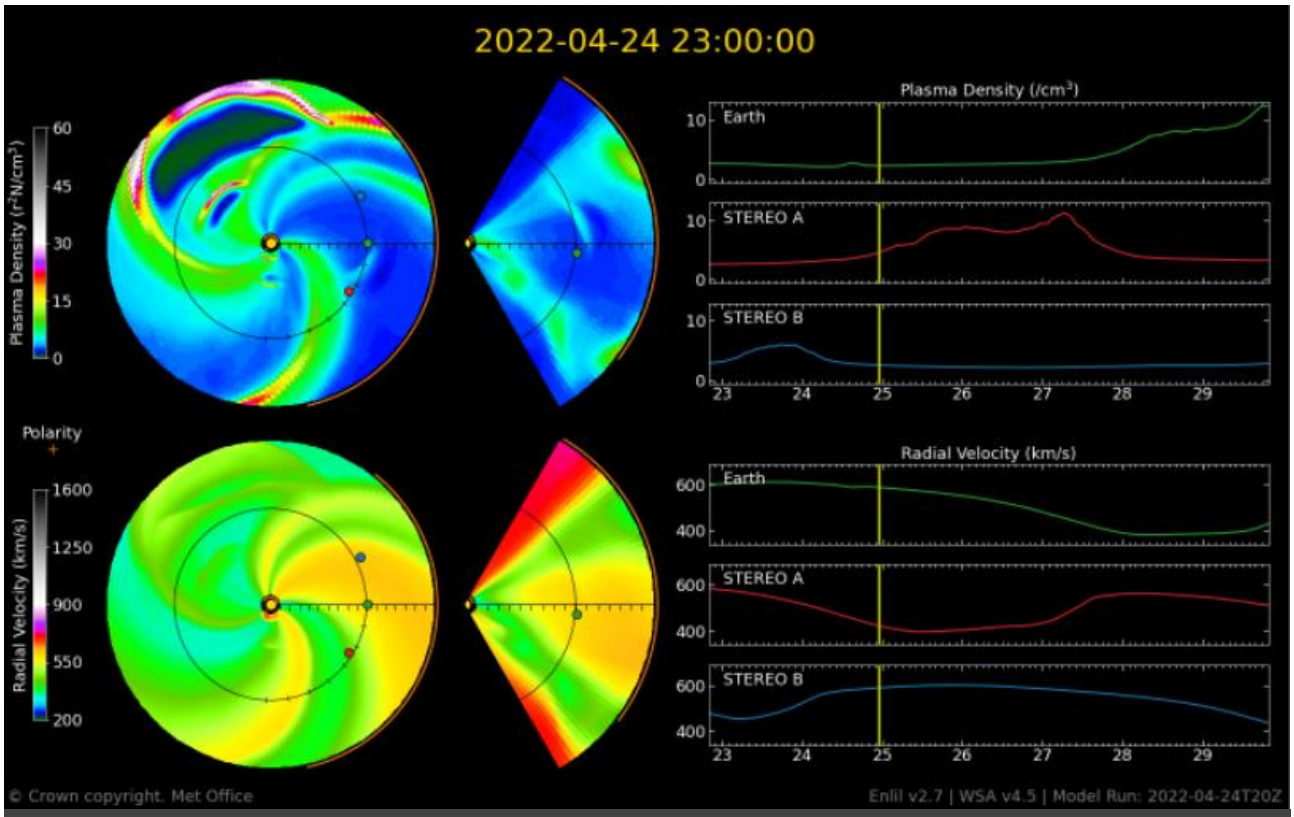
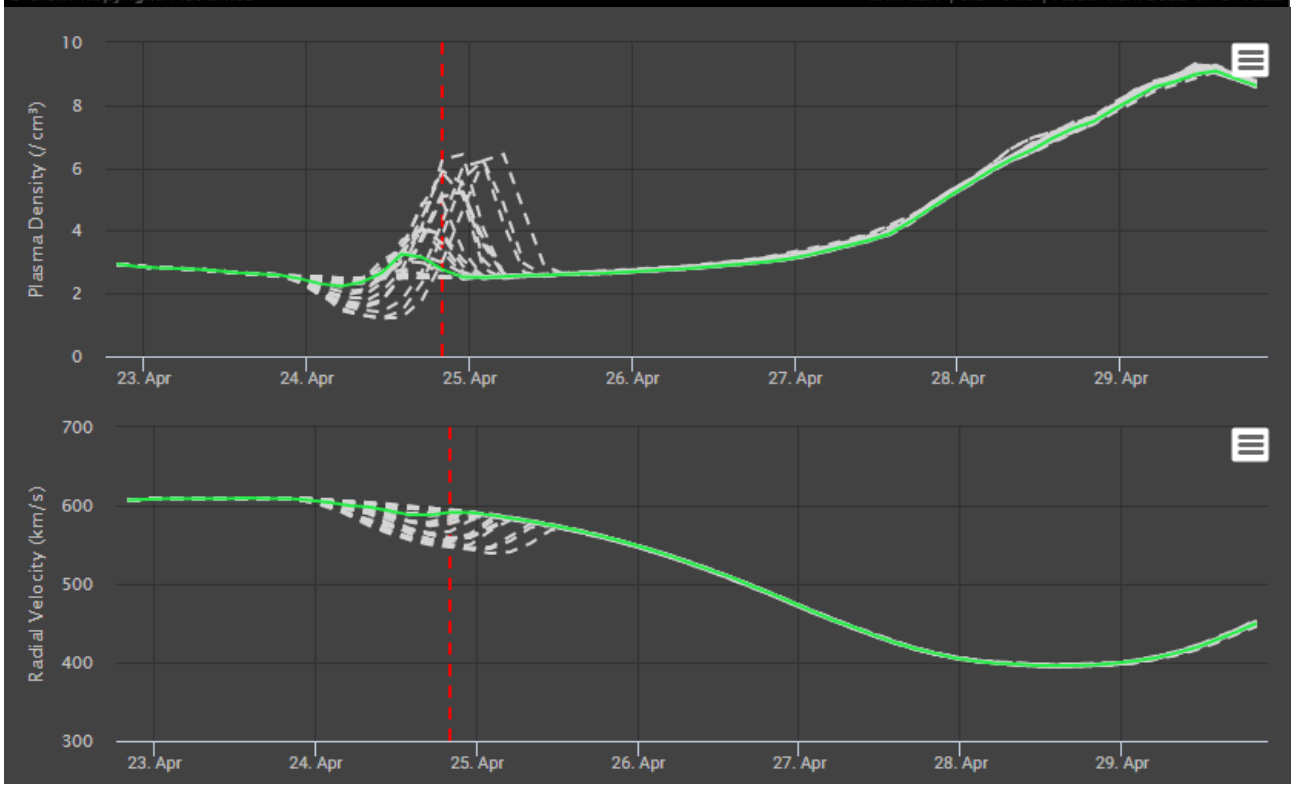
Figure 2: Enlil model and ensemble. Just a few ensemble members showing a possible glancing CME in the next few hours. Otherwise, Enlil is too high with wind speeds and considered to be too slow to reduce the wind speed, with a decline more likely within the next 24-48 hours.





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Radio Blackouts - X-Ray Flares:
Solar activity has been Low in the last 24 hours, with only C-class fares observed, predominately from AR2994 in the northwest quadrant, but also from near or over the southeast limb.

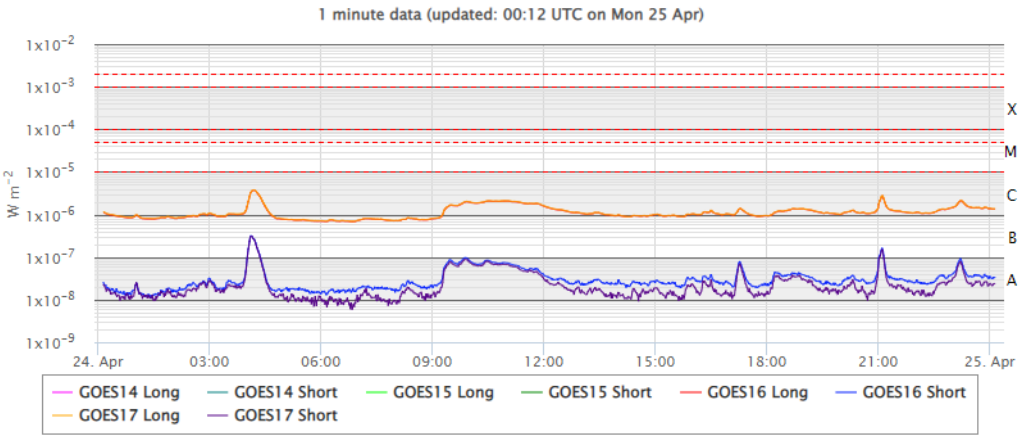
AR2993 and AR2994 are close together in the northwest, with some connection between their magnetic fields. AR2993 (Dki/Beta-Gamma) is a moderately sized region, and the source of numerous M-flares earlier in its transit. This region shows a north-south alignment in the magnetic field, which indicates some potential instability from magnetic shear. It also had a weak delta spot, which now appears to have separated into two spots. AR2994 (Ehi/Beta-Gamma) is a larger region consisting of two large separate penumbral regions with some intermediate spots. The trailing region was exhibiting a small delta area, but this appears to be closing up. This region has only produced 2 small M-flares since its X1.1 on the 17th, yet it still has sufficient flux for significant flares.

Three further sunspots follow in the northeast, and these are smaller and simpler, although the largest and most complex of these is AR2995 (Cho/Beta-Gamma). A further source of interest is the southeast limb, where AR2998 has rotated onto the disc. This currently appears to be a simple unipolar region, however the bright signal from over the limb on STEREO-A EUV imagery suggests the potential for further features to rotate onto the disc in the coming days.

There is a chance of M-class flares with a slight chance of X-class flares, and this risk may rise slightly in the coming days as new features rotate onto the southeast limb.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	40	50	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: Current X-ray trace shows only C-class flares.



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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at Background levels, and is most likely to remain so through the next four days. However, AR2993 and AR2994 both bring the possibility of isolated high M-class to low X-class flares (R2-R3 Radio blackouts). As they continue to move across the northwestern quadrant, there is a slight chance that solar radiation storms from any such events may be observed at Earth.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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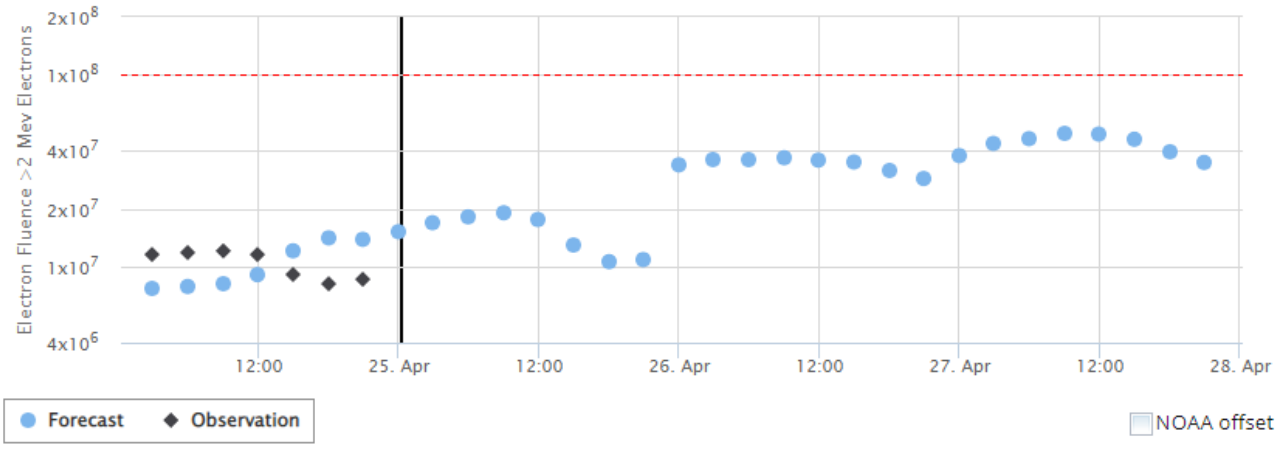
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) as measured by GOES-16 at GEO is expected to be at mainly background to moderate levels, perhaps with a slight rising trend. Any glancing CME interaction on Day 1 (25 Apr) will keep electron levels suppressed in the short term. Otherwise, we appear to be experiencing weak HSS effects from CH77, but with wind speeds mostly below 500 km/s and little to no geomagnetic response, a significant rise in electron flux is considered unlikely.

The associated 24 hour fluence values are expected to remain below the Active (1e8 integrated pfu) threshold, with just a slight chance of rising above by the end of the period. REFM is currently giving reasonable guidance, suggesting a modest rise below the Active threshold.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: REFM model is expected to be offering reasonable guidance.



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